

CLAIMS

1. A high-stiffness high-strength thin steel sheet comprising C: 0.02-0.15%, Si: not more than 1.5%, Mn: 1.5-4.0%, P: not more than 0.05%, S: not more than 0.01%, Al: not more than 1.5%, N: not more than 0.01% and Nb: 0.02-0.40% as mass%, provided that C, N and Nb contents satisfy the relationships of the following equations (1) and (2):

$$0.01 \leq C + (12/14) \times N - (12/92.9) \times Nb \leq 0.06 \quad \dots \quad (1)$$

$$N \leq (14/92.9) \times (Nb - 0.01) \quad \dots \quad (2)$$

- and the remainder being substantially iron and inevitable impurities, and having a texture comprising a ferrite phase as a main phase and having a martensite phase at an area ratio of not less than 1%, and having a tensile strength of not less than 590 MPa and a Young's modulus of not less than 225 GPa.

2. A high-stiffness high-strength thin steel sheet according to claim 1, which further contains one or two of Ti: 0.01-0.50% and V: 0.01-0.50% as mass% in addition to the above composition and satisfy the relationships of the following equations (3) and (4) instead of the equations (1) and (2):

$$0.01 \leq C + (12/14) \times N^* - (12/92.9) \times Nb - (12/47.9) \times Ti^* - (12/50.9) \times V \leq 0.06 \quad \dots \quad (3)$$

$$N^* \leq (14/92.9) \times (Nb - 0.01) \quad \dots \quad (4)$$

- provided that N^* in the equations (3) and (4) is $N^* = N - (14/47.9) \times Ti$ at $N - (14/47.9) \times Ti > 0$ and $N^* = 0$ at $N - (14/47.9) \times Ti \leq 0$, and Ti^* in the equation (3) is $Ti^* = Ti - (47.9/14) \times N - (47.9/32.1) \times S$ at $Ti - (47.9/14) \times N - (47.9/32.1) \times S > 0$ and $Ti^* = 0$ at $Ti - (47.9/14) \times N - (47.9/32.1) \times S \leq 0$.

3. A high-stiffness high-strength thin steel sheet according to claim 1 or 2, which further contains one or more of Cr: 0.1-1.0%, Ni: 0.1-1.0%, Mo: 0.1-1.0%, Cu: 0.1-2.0% and B: 0.0005-0.0030% as mass% in addition to the above composition.

4. A method for producing a high-stiffness high-strength thin steel sheet comprising subjecting a starting material of steel comprising C: 0.02-0.15%, Si: not more than 1.5%, Mn: 1.5-4.0%,

P: not more than 0.05%, S: not more than 0.01%, Al: not more than 1.5%, N: not more than 0.01% and Nb: 0.02-0.40% as mass%, provided that C, N and Nb contents satisfy the relationships of the following equations (1) and (2):

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$$0.01 \leq C + (12/14) \times N - (12/92.9) \times Nb \leq 0.06 \dots\dots (1)$$

$$N \leq (14/92.9) \times (Nb - 0.01) \dots\dots (2)$$

to a hot rolling step under conditions that a total rolling reduction below 950°C is not less than 30% and a finish rolling is terminated at Ar₃-900°C, coiling the hot rolled sheet below 650°C, pickling,
10 subjecting to a cold rolling at a rolling reduction of not less than 50%, raising a temperature to 780-900°C at a temperature rising rate from 500°C of 1-40°C/s to conduct soaking, and then cooling at a cooling rate up to 500°C of not less than 5°C/s to conduct annealing.

5. A method for producing a high-stiffness high-strength thin
15 steel sheet according to claim 4, wherein the starting material of steel further contains one or two of Ti: 0.01-0.50% and V: 0.01-0.50% as mass% in addition to the above composition and satisfies the relationships of the following equations (3) and (4) instead of the equations (1) and (2):

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$$0.01 \leq C + (12/14) \times N^* - (12/92.9) \times Nb - (12/47.9) \times Ti^* - (12/50.9) \times V \leq 0.06 \dots\dots (3)$$

$$N^* \leq (14/92.9) \times (Nb - 0.01) \dots\dots (4)$$

provided that N* in the equations (3) and (4) is N* = N - (14/47.9) × Ti at N - (14/47.9) × Ti > 0 and N* = 0 at N - (14/47.9) × Ti ≤ 0, and Ti* in the
25 equation (3) is Ti* = Ti - (47.9/14) × N - (47.9/32.1) × S at Ti - (47.9/14) × N - (47.9/32.1) × S > 0 and Ti* = 0 at Ti - (47.9/14) × N - (47.9/32.1) × S ≤ 0.

6. A method for producing a high-stiffness high-strength thin steel sheet according to claim 4 or 5, wherein the starting material of steel further contains one or more of Cr: 0.1-1.0%, Ni: 0.1-1.0%,
30 Mo: 0.1-1.0%, Cu: 0.1-2.0% and B: 0.0005-0.0030% as mass% in addition to the above composition.